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Taxonomy of tropical West African bivalves III. Four new species of Condylocardiidae from the continental shelf

by Carmen SALAS and Rudo VON COSEL

Abstract. — *Condylocardia boucheti* n. sp., from Mauritania, *C. angolensis* n. sp., *C. ameliae* n. sp. and *Carditopsis gofasi* n. sp., from Angola, are described. Incubating juveniles have been found in *Condylocardia boucheti, C. ameliae* and *Carditopsis gofasi.*

Résumé. — *Condylocardia boucheti* n. sp., de Mauritanie, *C. angolensis* n. sp., *C. ameliae* n. sp., *Carditopsis gofasi* n. sp., de l'Angola, sont décrites. L'incubation des jeunes a été constatée chez *Condylocardia boucheti, C. ameliae* et *Carditopsis gofasi*

C. SALAS, *Depto. Biologia Animal, Fac. Ciencias, Universidad de Málaga, E-29071 Málaga (Espãna).*
R. VON COSEL, *Laboratoire de Biologie des Invertébrés marins et Malacologie, Muséum national d'Histoire naturelle, 55, rue Buffon, F-75005 Paris (France).*

This paper is the continuation of a previous contribution, where four new species of *Condylocardia* from the Cape Verde Islands were described (SALAS and ROLÁN, 1990). The species from the West African mainland coast are now considered. Two species of Condylocardiidae are hitherto described from this area : *Carditopsis dartevellei* Nicklès, 1952 and *Cuna gambiensis* Nicklès, 1955. One South African species, *Carditella capensis* Smith, 1885, has been reported from Angola (Baia dos Tigres) by THIELE and JAECKEL (1931 : 213) and found again in our material from the same locality (1 specimen collected alive, leg. GOFAS, 1986). Four other species, three from Angola and one from Mauritania, are described herein.

Condylocardia boucheti n. sp.

(Fig. 1-8)

TYPE MATERIAL : Holotype MNHN (1.4 mm length × 1.25 mm height), shell with two incubating juveniles in protoconch stages inside; leg. BOUCHET, May 1983.

TYPE LOCALITY : Baie de l'Étoile (21° N), Mauritania.

DESCRIPTION

Shell minute, subtrigonal, slightly longer than high, thick and solid, very inflated. Beaks slightly behind the vertical midline. Surface with 10 broad and prominent radial ribs, with

interspaces slightly narrower than the ribs. There are also fine and concentric striae, forming small knobs and incisions on the radial ribs, especially on the marginal part of the valves. Lunule and escutcheon long and rather broad, delimited by the first and last radial rib. Protoconch large in relation to the adult shell, prominent, with numerous weak, irregular, radial ribs, some of them bifurcating. The protoconch is separated from the teleoconch by a broad and well-defined rim.

Periostracum very thin and colourless, persistent mostly in the interspaces of the radial ribs and the marginal part of the valves. Inner margin denticulate, reflecting the external sculpture. Small internal ligament, in oval resilium.

Hinge broad with spondyliform margin. Right valve with two cardinals, the anterior one a prominent tubercle next to the lower margin of the cardinal area; the posterior one short and somewhat trigonal, not reaching the lower margin; one anterior and one posterior lateral, equivalent in size. Left valve with three cardinals, the anterior one (apparently broken) oblique, not reaching the upper margin of the cardinal area and distally pointing to the lateral, the second cardinal short and trigonal, not reaching the lower margin of the hinge; the posterior cardinal oblique, somewhat prominent, reaching close to the lower margin of the cardinal are and distally pointing to the lateral; one anterior and one posterior lateral, equivalent in size.

Two oval and ill-defined adductor muscle scars beneath the distal part of lateral teeth. Pallial line entire and ill-defined.

Outside whitish with light brownish areas. Inside dull whitish and brownish, according to external colouration, which is showing through. The incubated protoconchs are white.

DISTRIBUTION : Only known from Mauritania.

MATERIAL EXAMINED : The holotype.

BIOTOPE : Unknown; the specimen was found in seagrass bed and mud, from the intertidal zone.

DERIVATIO NOMINIS : The species is dedicated to our colleague Philippe BOUCHET, who collected the holotype.

REMARKS

This species resembles superficially *Condylocardia carditoides* (Salas & Rolán, 1990) from Cape Verde Islands, but this latter is somewhat higher and has 11-14 ribs instead of 10. The protoconchs of both species are rather similar. The hinge plate of *C. boucheti* has a broader, more spondyliform central part.

The presence of two incubating juveniles inside the shell proves that it is adult despite its very small size.

Condylocardia angolensis n. sp.
(Fig. 9-24)

TYPE MATERIAL : Holotype MNHN, left valve (1.8 mm length × 1.6 mm height). Paratype : MNHN, one shell and one right valve, Lucira (Sta. Marta); two right valves, Lucira (Bissonga); MNCN, 1 right valve and one left valve, Lucira (Sta. Marta); IICT, 1 right valve and 1 left valve, Lucira (Sta. Marta); all leg GOFAS, 1981-86.

TYPE LOCALITY : Bay of Lucira (Bissonga), Namibe province, Angola, 10-20 m, in maerl.

DESCRIPTION

Shell minute, 1.8-2.3 mm long, obliquely oval-subtrigonal, longer than high, inflated, rather thick and solid. Beaks in front of the vertical midline. Surface with 14-15 strong, elevated, rounded radial ribs with narrow, but well marked interspaces crossed by a concentric sculpture. The latter consists of very thin lamellae in the interspaces of the ribs and weak constrictions on the ribs themselves, giving them a somewhat nodose appearance. Lunule and escutcheon very small and ill-defined. Embryonic shell with protoconch I and protoconch II, separated by a strong rim. Protoconch I smaller, with concentric, irregular and somewhat deep furrows; protoconch II rather large, with prominent, narrow, concentric ridges crossed by less apparent radial ridges, giving a nodular appearance. The protoconch is separated from the teleoconch by a prominent rim.

Periostracum very thin and colourless, persistent only in the interspaces of the ribs. Inner margin denticulate according to the external ribs. Ligament entirely internal, in a central, somewhat subtrigonal resilifer.

Hinge broad, with spondyliform hinge margin, slightly different in small (juvenile) and large (adult) specimens. In small sizes : Right valve with three cardinals; the two anterior ones fused proximally forming a hook and reaching distally the lower margin of the cardinal area; the posterior cardinal short and trigonal, not reaching the lower margin; one anterior and one posterior lateral, the anterior one stronger. Left valve with three cardinals, the anterior one prominent, oblique, not reaching the upper margin of the cardinal area and distally pointing to the lateral; the second cardinal short and trigonal, not reaching the lower margin of the hinge; the posterior cardinal oblique, somewhat prominent, not reaching the lower margin of the cardinal area and distally pointing to the lateral. In large size : Right valve with the posterior cardinal merged to the posterior dorsal margin of the shell, the two anterior cardinals as above. Left valve with the anterior cardinal reaching the upper margin of the cardinal area, the second cardinal enlarged and nearly reaching the lower margin of the cardinal area; the posterior cardinal completely merged to the posterior dorsal margin of the shell; one anterior and one stronger posterior lateral.

Anterior and posterior dorsal margins with minute crenulations. Two suboval ill-defined adductor muscle scars beneath the distal part of the lateral teeth. Pallial line entire and ill-defined.

Outside white, with small light brown spots or irregular zones. Inside white, with external colouration showing through.

DISTRIBUTION : Known only from a small area on the coast of southern Angola, from Bay of Lucira to Praia Amelia, Namibe province. No living specimens have yet been found.

MATERIAL EXAMINED : Bay of Lucira (Bissonga) : 1 lot with the holotype and 1 paratype; Bay of Lucira (Cesar) : 1 lot with 10 valves; Bay of Lucira (Santa Marta) : 1 lot with 1 shell and 10 valves, paratypes; Praia Amelia, 2 right valves and 1 left valve : all leg. GOFAS, 1983-86.

BIOTOPE : Unknown. The shells and valves were found in mixed and coarse sand with shell debris and calcareous algae, offshore from 10 to 60 m, not common.

DERIVATIO NOMINIS : The species is named after Angola.

REMARKS

C. angolensis can only be compared with the capeverdian *C. carditoides* (Salas & Rolán, 1990), but is much more oval. The protoconch is divided in protoconch I and protoconch II in *C. angolensis* with its genuine concentric sculpture in both parts, it is simple and has a radial sculpture in *C. carditoides*. The hinge of juvenile *C. angolensis* is close to those of *C. verdensis* (Salas & Rolán, 1990) and *C. boucheti* n. sp.

Condylocardia ameliae n. sp.

(Fig. 25-32)

TYPE MATERIAL : Holotype MNHN : 1 shell (2.1 mm length × 1.6 mm height). Paratypes (all from the type locality) : MNHN, 5 shells; MNCN, 4 shells, 1 right valve and 1 left valve; IICT, 4 shells, 1 right valve and 1 left valve; all leg. GOFAS, July 1986.

TYPE LOCALITY : Praia Amelia, Namibe province, Angola, 40-60 m.

DESCRIPTION

Shell minute, 2.0-2.2 mm long, obliquely subtriangular, longer than high, inflated, rather thick and solid. Beaks opisthogyrate, on the vertical midline. Surface with 13-14 prominent, rounded radial ribs, all starting from the protoconch rim, with marked interspaces, slightly narrower than the ribs. Concentric sculpture of fine lamellae, more conspicuous in the interspaces. Lunule deep and well marked; escutcheon narrow and ill-defined. Embryonic shell with protoconch I and protoconch II delimited by a concentric rim. Protoconch I with an irregular sculpture of radial riblets and furrows; protoconch II nearly smooth, separated from the teleoconch by a well marked rim.

Periostracum thin, almost colourless, more conspicuous in the interspaces of the ribs and margins. Inner margins denticulate according to the external sculpture, which is reflected on the interior of the shell. Ligament small, internal, in subtrigonal and subcentral resilifer under the protoconch margin.

Hinge broad and prominent, with spondyliform central hinge plate. Right valve with two divergent anterior cardinals, fused proximally forming a hook, the foremost one elongated,

less prominent and distally pointing to the lateral, the other one triangular, very prominent and nearly vertical, reaching the lower margin, of the cardinal area. One small, triangular and very short posterior cardinal, not reaching the lower margin of the cardinal area. One anterior and one less apparent posterior lateral. Left valve with two divergent anterior cardinals, the first one very prominent, obliquely reaching the margins of the cardinal area and distally pointing to the lateral, the second one hardly prominent, narrower, vertical and nearly reaching the margins of the cardinal area; one prominent posterior cardinal, somewhat prolongated to reach the margins of the cardinal area and distally pointing to the lateral; one anterior and one posterior lateral, the former less apparent.

Two oval and hardly visible adductor muscle scars beneath the distal part of lateral teeth. Pallial line entire and ill-defined.

Outside white, light brownish or brown, with paler beaks. Inside with external colouration showing through.

DISTRIBUTION : Known only from Praia Amelia (Southern Angola).

MATERIAL EXAMINED : Southern Angola : Praia Amelia : 1 lot with 104 specimens or shells and 85 valves (included the type material), leg. GOFAS, July 1986.

BIOTOPE : The lot from Praia Amelia was found in mixed and coarse sand, offshore from 40-60 m.

DERIVATIO NOMINIS : The species is named after the the type locality.

REMARKS

This species resembles in outline *Carditopsis gofasi* n. sp., however it is smaller, longer than high and has a pointed posterior margin. All ribs start from the protoconch rim, whereas in *C. gofasi*, some ribs are bifurcating. The hinge of *C. ameliae* has a much narrower, spondyliform central hinge plate and somewhat longer laterals; in *C. gofasi*, the cardinals are much closer to each other and the hinge plate is not spondyliform.

A few specimens were opened and one of them found to contain 9 brooded juveniles in protoconch stage.

Carditopsis gofasi n. sp.
(Fig. 33-47)

TYPE MATERIAL : Holotype MNHN (2 mm length × 1.9 mm height). Paratypes (all from type locality) : MNHN, 5 specimens (1 with larval shells included); MNCN, 4 specimens; IICT, 4 specimens; all leg. GOFAS, 1981-86.

TYPE LOCALITY : Ilha de Luanda, Luanda province, Angola; 40-60 m, in shell sand.

DESCRIPTION

Shell very small, 2-4 mm long, rounded-subtrigonal, slightly higher than long or as high as long, rather inflated, thick and solid. Beaks close to the vertical midline. Surface with 14-17

prominent, rounded, radial ribs with very narrow but marked interspaces. Central ribs bifurcating along the vertical midline on the earlier part of the teleoconch. Interspaces with fine concentric lamellae, obsolete on the ribs. Lunule rather deep, escutcheon narrow, both ill-defined. Embryonic shell with both protoconch I and protoconch II delimited by a concentric rim. Protoconch I with strong, irregular radial ribs separated by deep furrows; protoconch II nearly smooth.

Periostracum very thin, nearly colourless, persistent only in the interspaces of the ribs and near the margins. Inner margin denticulate according to the external sculpture. Ligament small, internal, in subrounded and about central resilifer, just beneath the protoconch margin.

Hinge broad and prominent. Right valve with two divergent anterior cardinals, the foremost one elongate, less visible and merged to the posterior dorsal margin of the cardinal area, the second one very prominent and triangular; posterior cardinal not visible and completely merged to the posterior dorsal margin of the cardinal area. One anterior and one posterior lateral, the anterior one more prominent. Left valve with two divergent anterior cardinals, the foremost one very strong, prominent and reaching the margin of the protoconch, the other one very small and not reaching the margin of the protoconch. One vertical, elongate and not much apparent posterior cardinal. One anterior and one more prominent posterior lateral.

Anterior and posterior dorsal margins with minute crenulations. Two reniform to oval adductor muscle scars beneath the distal part of lateral teeth. Pallial line entire and ill-defined.

Outside whitish, white with brown on the anterior part or occasionally entirely brown. Inside white, with exterior colouration showing through.

DISTRIBUTION : Northern Angola (Ambrizete, Zaire province) to southern Angola (Lucira, Namibe province).

MATERIAL EXAMINED : **Northern Angola** : Ambrizete (Zaire province), box cores, 40-80 m : 5 lots (leg. GOFAS, MNHN); Cacuaco (Bengo province), 5-10 m : 2 lots (leg. GOFAS, MNHN), 1 lot (leg. ROLÁN); Ilha de Luanda (Luanda province), 40-60 m : the type material (holotype and paratypes), with living specimens and 3 other lots (MNHN), 1 lot (leg. ROLÁN); off Mussulo (Luanda province), 90-100 m : 4 lots (leg. GOFAS, MNHN), 1 lot (leg. ROLÁN); off Mussulo, 120 m, 1 lot (leg. GOFAS, MNHN). **Southern Angola** : Bay of Santa Maria (Benguela province) : 2 lots; Bay of Lucira (Namibe province) : 5 lots; all leg. GOFAS, 1981-86.

BIOTOPE : In fine, mixed or coarse sand, often with shell debris, from shallow water (5-10 m), but generally more offshore in 40-100 m, common

DERIVATIO NOMINIS : This species named after our colleague Serge GOFAS who dredged extensively on the coast of Angola and collected most material dealt with in this paper.

REMARKS

The new species is rather close in outline to *Carditopsis dartevellei* Nicklès, 1952, and *Condylocardia ameliae* n. sp., but in these, the middle ribs are never bifurcated. Moreover, the ribs in *C. dartevellei* are more prominent, with scales, and *C. ameliae* has fewer radial ribs. A dozen of the live collected specimens have been opened. Two of these, one from Ilha de Luanda (40-60 m) and the other from Bay of Lucira (Praia Cesar, 10 m), contained each 15 to

20 incubating juveniles in protoconch stage (fig. 42-47). This confirms the incubator character (WALLER, 1973) of the genus *Carditopsis*, which in this case develops a greater number of offspring than any West African *Condylocardia* we have seen.

Our orientation of valves is guided by the position of foot and gill filament in the examined specimens. The orientation of the shell of *Carditopsis dartevellei* given by NICKLÈS (1952) is reverse and deemed to be incorrect.

CONCLUDING REMARKS

Hinge characters of the three species *Carditopsis gofasi*, *Condylocardia ameliae* and *C. angolensis* are interpreted as increasingly neotenous. The large cardinal tooth in the left valve of *C. gofasi* is not essentially different from the cardinal tooth of *C. ameliae* but in this latter species, the cardinal tooth is not so large and is fused with the posterior lateral to form the genuine hook shaped structure of *Condylocardia*. In *C. angolensis* (or *C. bouchetî*), the hook-shaped structure is conspicuous and the cardinal is not obviously triangular. *Carditopsis* and *Condylocardia* are hence extremely closely related.

Museum abbreviations

MNHN : Muséum National d'Histoire Naturelle (Paris).
MNCN : Museo Nacional de Ciencias Naturales (Madrid).
IICT : Instituto de Investigação Cientifica Tropical (Centro de Zoologia) (Lisbon).

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We are indebted to Serge GOFAS, who collected and donated most material of the Angolan species, to Emilio ROLÁN who donated additional Angolan material and to Philippe BOUCHET, who contributed the Mauritanian species. We are grateful to S. GOFAS and P. BOUCHET for critically reading the manuscript. Gregorio Martin CABALLERO and Juan José Canca CUENCA operated for us the scanning electron microscope of the University of Málaga.

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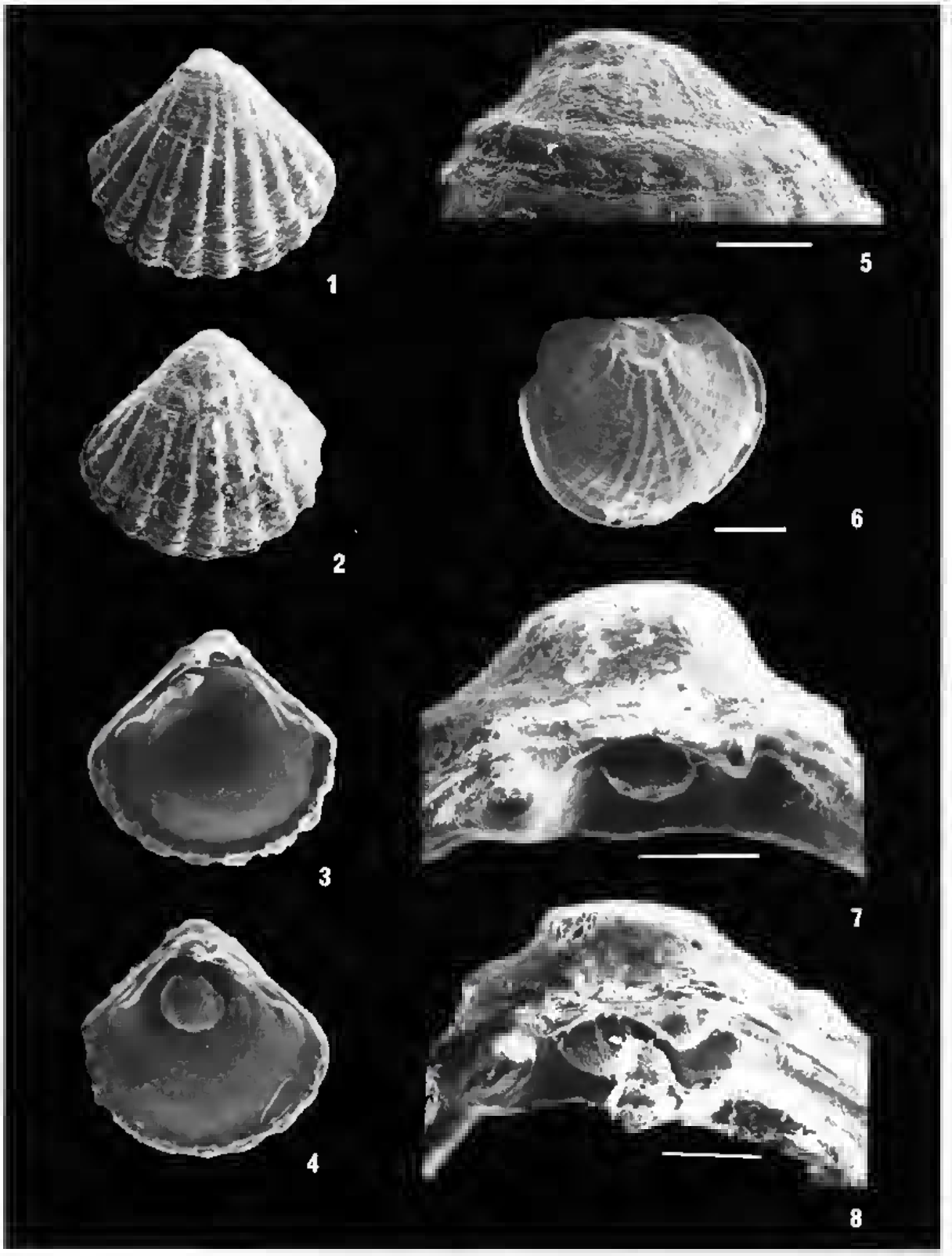
FIG. I-8. — *Condylocardia boucheti* n. sp. (holotype MNHN). Scale bars are 100 µm.

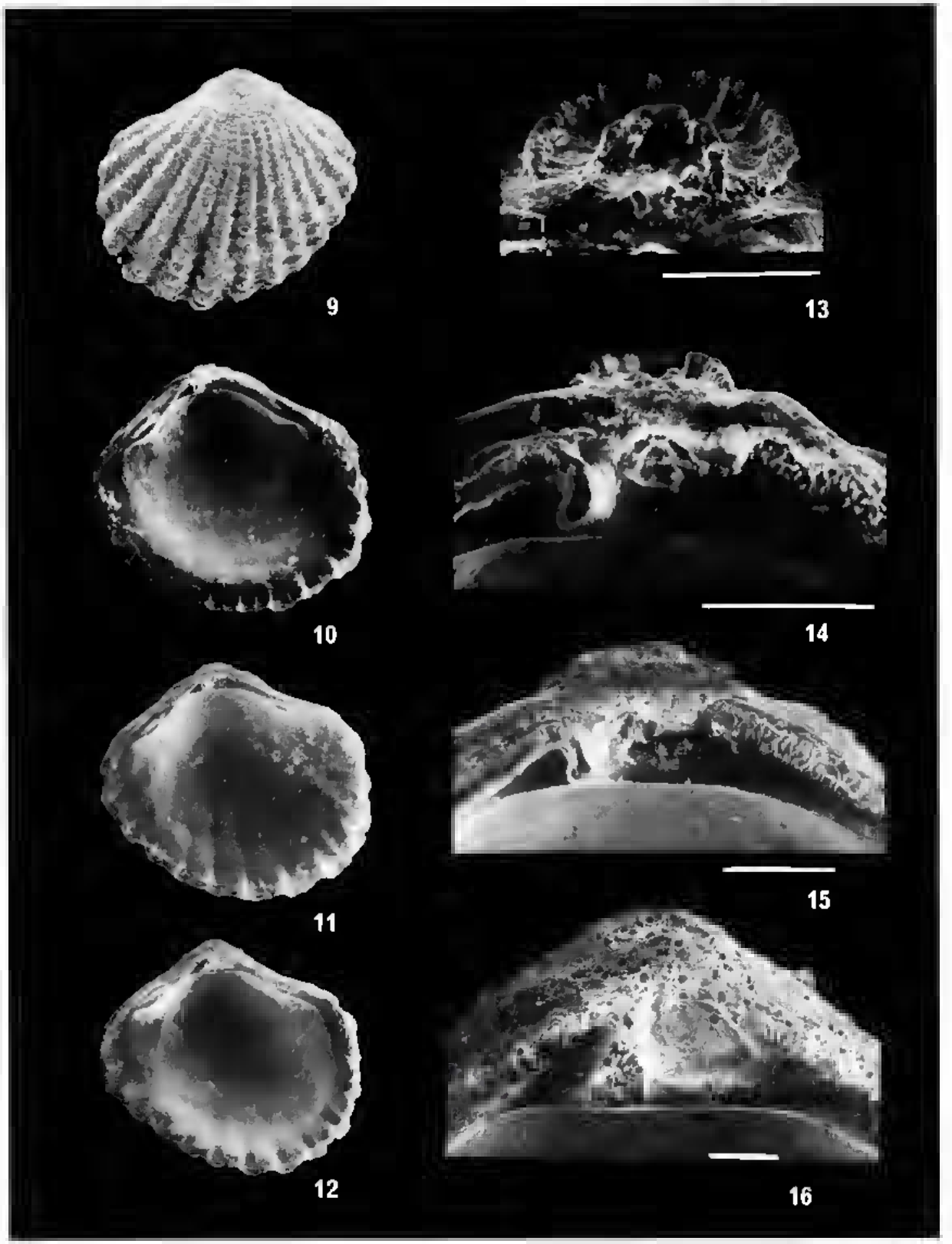
1. Exterior of right valve. Baie de l'Étoile. Actual length 1.4 mm.
2. Exterior of left valve.
3. Interior of right valve with incubating larval shells.
4. Interior of left valve with incubating larval shells.
5. Protoconch of right valve.
6. Incubating larval shell.
7. Cardinal area of right valve (fig. 3).
8. Cardinal area of left valve (fig. 4).



Source : MNHN, Paris

FIG. 9-16. — *Condylocardia angolensis* n. sp. (right valves). Scales bars are 100 μm.

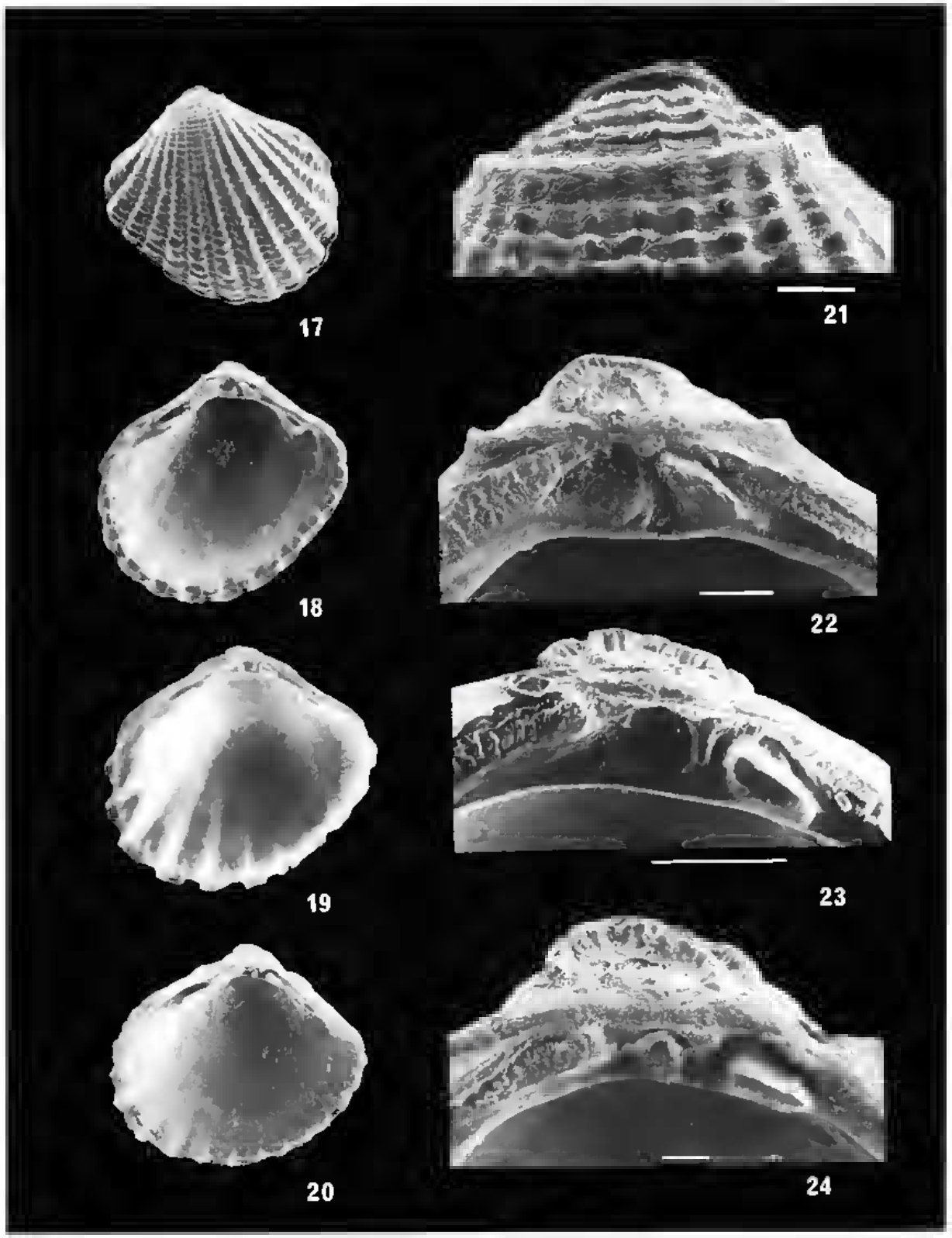
9. Exterior. Lucira (Sta. Marta). Actual length 1.5 mm. MNCN
10. Interior. Lucira (Sta. Marta). Actual length 1.1 mm. MNHN.
11. Interior of another valve. Lucira (Sta. Marta). Actual length 1.2 mm. IICT.
12. Interior. Lucira (Bissonga). Actual length 2.1 mm. MNHN.
13. Protoconch. Lucira (Sta. Marta).
14 Cardinal area (fig. 10).
15. Cardinal area (fig, 11).
16. Cardinal area (fig. 12).



Source : MNHN, Paris

FIG. 17-24. — *Condylocardia angolensis* n. sp. (left valves). Scale bars are 100 µm.

17. Exterior of holotype. Lucira (Bissonga). Actual length 1.8 mm. MNHN.
18. Interior of holotype.
19. Interior of paratype. Lucira (Sta. Marta). Actual length 1.2 mm. MNCN.
20. Interior of paratype. Lucira (Sta Marta). Actual length 1.1 mm. IICT.
21 Protoconch of holotype.
22. Cardinal area (fig 18).
23. Cardinal area (fig. 19).
24. Cardinal area (fig. 20).



Source : MNHN, Paris

FIG. 25-32. — *Condylocardia ameliae* n. sp. Scale bars are 100 µm.

25. Exterior of right valve. Holotype. Praia Amelia, Namibe. Actual length 2.1 mm. MNHN.
26. Exterior of left valve. Holotype.
27. Interior of right valve. Paratype. Praia Amelia, Namibe. Actual length 1.6 mm MNHN.
28. Interior of left valve, same paratype.
29. Protoconch (fig. 25).
30. Protoconch of another left valve. Praia Amelia, Namibe.
31. Cardinal area of right valve (fig. 27).
32. Cardinal area of left valve (fig. 28).

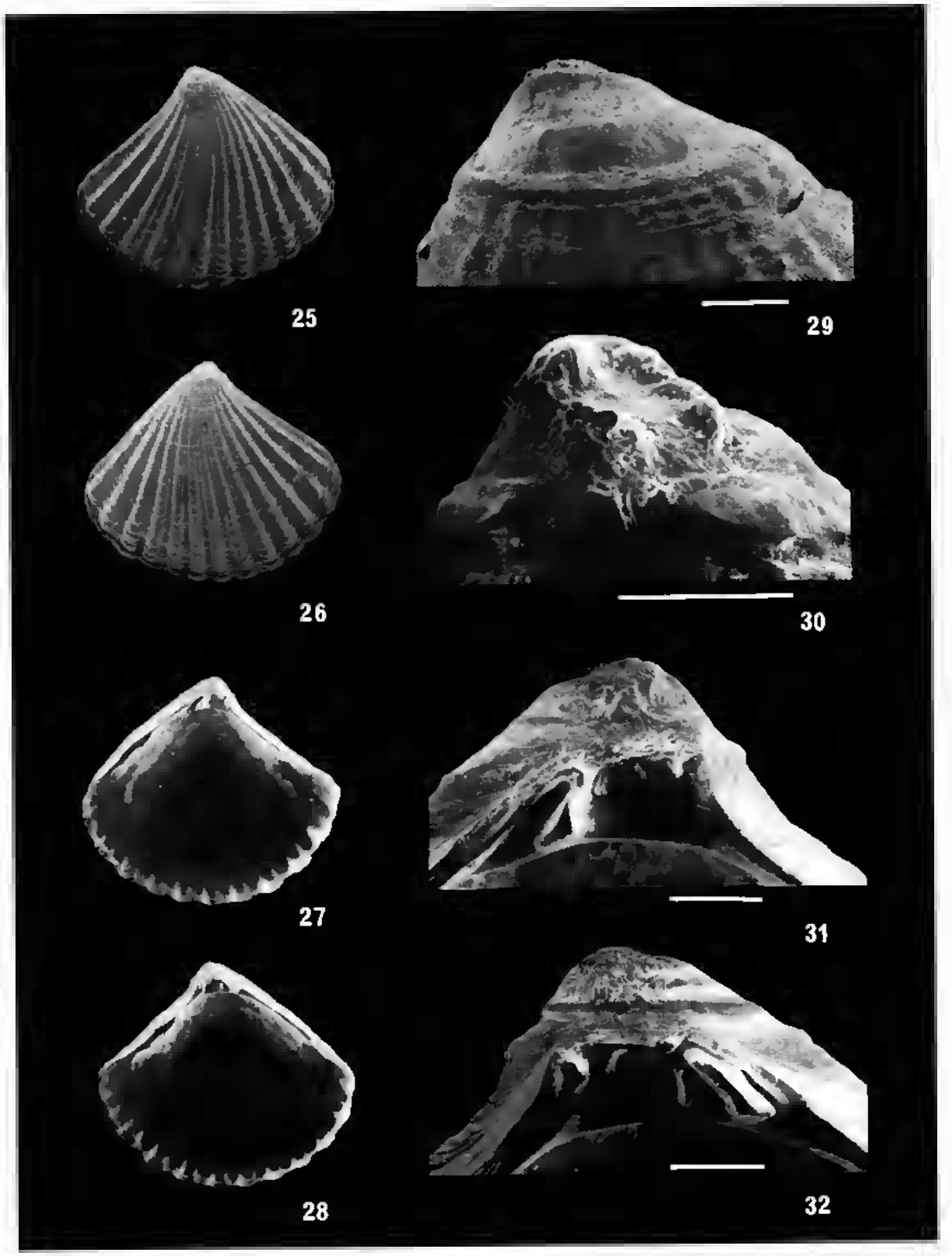
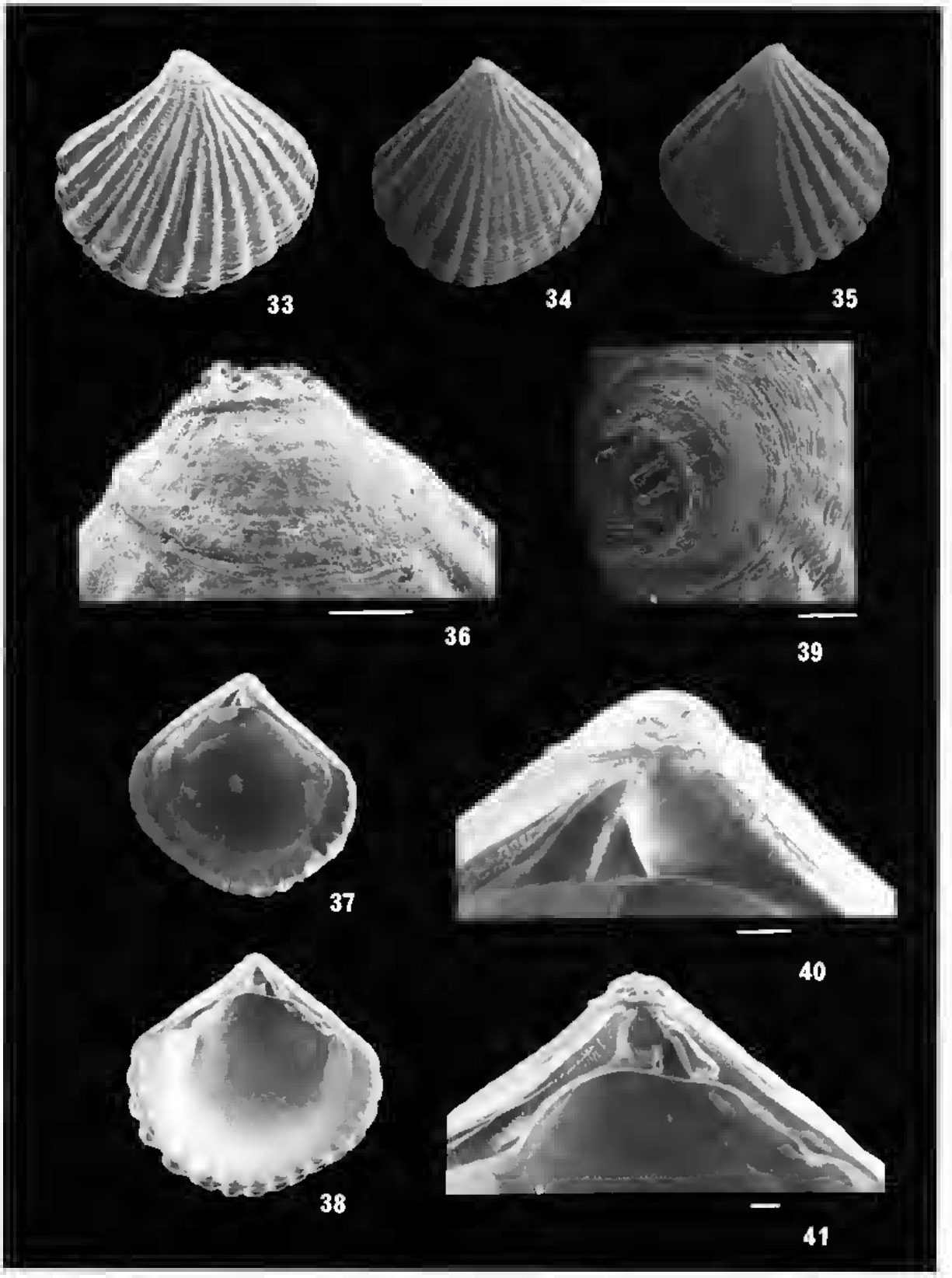


FIG. 33-41. — *Carditopsis gofasi* n. sp. Scale bars are 100 µm.

33. Exterior of right valve. Holotype. Ilha de Luanda. Actual length 2.1 mm. MNHN.
34. Exterior of right valve Paratype. Ilha de Luanda. Actual length 2.2 mm. MNHN.
35. Exterior of left valve, same paratype.
36. Protoconch.
37. Interior of right valve. Ambrizete. Actual length 2.5 mm. MNHN.
38. Interior of left valve. Ambrizete. Actual length 2.2 mm. MNHN.
39. Protoconch.
40. Cardinal area of right valve (fig. 37).
41. Cardinal area of left valve (fig 38)



Source : MNHN, Paris

FIG. 42-47. — *Carditopsis gofasi* n. sp. Scale bars are 50 µm.

42. Interior of a left valve with incubating larval shells. Lucira (Praia Cesar). Actual length 3.3 mm.MNHN.
43. Detail of fig. 42, showing incubating larval shells, foot and gill filaments.
44. Interior of right valve with incubating larval shells. Ilha de Luanda. Actual length 2.3 mm. MNHN
45. Detail of fig. 44, showing incubating larval shells and remains of adductor muscles.
46. Interior of left valve of same specimen with incubating larval shells.
47. Detail of fig. 46, showing incubating larval shells and remains of gill filaments.